TOC Real Time Monitoring

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Project Workplan Outline

Real Time Monitoring for Organic Carbon in the Sacramento - San Joaquin Delta: System Development and Deployment

Background

Waters of the Sacramento-San Joaquin Delta serve nearly 23 million people (two-thirds of California's population) living in the Bay-Delta region and in southern California. The Delta as a drinking water supply is, therefore, important to the public health and economy of the State.

One of the primary drinking water quality problems associated with the use of Delta waters as a drinking water source is the formation of disinfection byproducts (DBPs). Disinfection, which is necessary to protect against microbial disease, produces chemical byproducts (DBPs such as trihalomethanes and haloacetic acids) that may pose other health risks such as cancer, spontaneous abortions, and other acute adverse health effects (e.g., liver toxicity, kidney toxicity, and nervous system toxicity). DBPs are produced when chemicals used in the treatment process react with constituents in the source water. A primary concern when chlorine is used as a disinfectant in treatment is that it reacts with organic matter (measured as total organic carbon [TOC] or dissolved organic carbon [DOC]) to form trihalomethanes (THMs) and other DBPs (e.g. haloacetic acids), which are known to be toxic and carcinogenic.

TOC arises from a wide variety of sources incident to and within the Delta. More quantitative information is needed about sources, loads, and temporal variability of TOC. Some sources are:

- Agricultural Drainage (including island seepage)
- Wetlands
- Flooded Islands
- Riparian Vegetation
- Algae
- Rice Field Drainage

- Natural Runoff
- Urban Runoff
- Bypass Flooding (seasonal inundation)
- Wastewater Discharges

In order to manage and improve the quality of waters in the Delta used for drinking water supply, the CALFED Drinking Water Program is in the process of synthesizing information and designing actions that will achieve continuous water quality improvement (with respect to DBPs) over the course of the next seven years.

This project will develop and implement a monitoring system that can be used to address key data gaps for three broad information needs: baseline water quality conditions in source waters and diverted drinking water supplies, TOC loading from riverine sources, and assessment of continuous water quality improvement during the first phase of CALFED.

Project Purpose

The purposes of this project are to obtain precise information on the loads, timing, and quality of carbon flowing into the Delta from the two largest sources of TOC—the Sacramento and San Joaquin Rivers; and to establish baseline conditions and real time monitoring capability for TOC that can potentially be diverted into drinking water supplies.

CALFED has developed several actions for implementation by each of its Programs, many of which have the potential to impact drinking water quality. The CALFED Drinking Water Quality Program has several proposed actions designed to improve drinking water quality. One of the key drinking water quality parameters likely to be affected by these projects is organic carbon. In order to assess the projected or actual impacts of these actions, appropriate water quality data will need to be collected at critical points in the Delta. This will require real-time monitoring in order to provide adequate data for making these assessments by way of computer modeling.

Real-time monitoring of organic carbon (TOC/DOC) has not been conducted in the Delta in the past. TOC/DOC data has typically been collected as grab samples for laboratory analysis on a weekly or monthly basis. This frequency of data has proven of limited value in establishing baseline water quality conditions or in assessing the sources and loads of TOC/DOC in the system. CMARP identified a need for monitoring TOC/DOC in a real-time network with sufficient accuracy to identify changes is sources and loadings that result from CALFED actions and alternatives.

This project will design and implement a sample collection and analysis system for collecting real-time TOC/DOC data at critical boundary locations to the Delta (Sacramento and San Joaquin River inputs, and Banks pumping plant export).

Once operational, monitoring data provided by this network could be used to help answer the following questions of importance to the CALFED Water Quality Program:

- What are the baseline concentrations of TOC and other constituents of concern in Delta waters, and what frequency of monitoring is needed to determine them?
- What is the quality of that TOC with respect to DBP formation potential?
- What are the sources of TOC loads to and within the Delta?
- Which sources contribute the most loads and most reactive forms of TOC to drinking water supplies, and when?
- Has there been a continuous improvement of source water quality as a result of the combined load, discharge, and flow management actions taken by the CALFED program?
- Are there management actions that can be taken to reduce the most problematic loads or segregate those waters from drinking water supply?

Resulting data can also be used in models currently being developed and tested by CALFED that will provide a means of establishing baseline water quality conditions, assessing the sources and loads of TOC/DOC, and evaluating the impacts or success of CALFED Program Actions on drinking water quality.

Project Description

This project has four basic elements:

1. Develop and field test TOC/DOC autoanalyzer system;
2. Field testing a multi-parameter, high frequency, automated monitoring station at Hood (one of the boundaries);
3. Installing an automated TOC monitoring system at Banks; and
4. Establishing a new automated multipurpose (including TOC/DOC) monitoring station on the San Joaquin to serve as the southern boundary.

Project Tasks

Task 1: Develop and Evaluate Real-Time TOC/DOC Autoanalyzer System, Install Turbidimeter and Flow Meter, and Related Equipment at Hood (Sacramento River; One Of The Delta Boundary Points).

The Hood monitoring station on the Sacramento River maintained by the Environmental Services Office on the Sacramento River was selected as the site for the pilot testing of

the TOC/DOC autoanalyzer because: a) the infrastructure capable of housing all instruments currently exists; b) it is located on the main channel of the Sacramento and it can be used as a major input or boundary point for the Delta; and c) data from this site can be used as a baseline should CALFED decide to construct a second cross-channel.

Task 1A: Select, install, field test, and calibrate equipment

Task 1A1: TOC/DOC Autoanalyzer Feasibility Evaluation, Installation, and Calibration (MWQI):

This task involves selecting the appropriate technology for TOC/DOC autoanalyzers for deployment at Hood and similar sites, developing and installing the ancillary hardware, and calibrating the equipment. MWQI will:

- Evaluate TOC/DOC analyzers not previously used by MWQI to test their adaptability and feasibility for use in the field as a real-time TOC/DOC analysis device;
- Select the best one for use in implementing the monitoring network;
- Develop the associated hardware, plumbing and electrical systems (pumps, flow tubing, filtering system, etc.) needed for sample collection and analysis in order to provide accurate, reproducible TOC/DOC data on a consistent, real-time basis;
- Develop data transfer systems, including data loggers and necessary telemetry equipment for remote downloading of data.
- Install all monitoring equipment at Hood and calibrate

Task 1A2: Install and calibrate equipment for high frequency turbidity measurements (ESO)
There is currently no real-time turbidity measurement device at Hood. This item includes purchasing, installing, and calibrating a turbidity measurement device and integrating it into the existing equipment.

Task 1A3: Install real-time flow monitoring station (Central District)
There is currently no flow measurement device at the Hood site. This task involves the site characterization and installation of an acoustic Doppler current profiler sensor. Site characterization includes measuring channel flows to develop necessary ratings for flow sensors. Installation includes positioning the sensors and securing ancillary equipment such as cables and data loggers for telemetering data.

Concurrent sampling by MWQI during the site characterization work will enable MWQI to develop information on any lateral variability of TOC/DOC across the channel.

Task 1B: Conduct Feasibility Study of TOC/DOC Autoanalyzer at Hood Site.

Task 1B1: Maintain TOC/DOC autoanalyzer and sample real-time for one year (MWQI).

Task 1B2: Collect grab samples for lab analysis and comparison to autoanalyzer data for evaluation of autoanalyzer sensitivity and accuracy (MWQI).

Task 1B3: Evaluate autoanalyzer and grab sample data (MWQI).

Task 1B4: Prepare draft and final feasibility reports (MWQI)

Task 2: San Joaquin River Channel Site Evaluation Study

The Vernalis monitoring site on the San Joaquin provides critical information for a number of different CALFED agency programs, including VAMP, real-time modeling efforts, and work on dissolved oxygen in the Stockton ship channel. Despite its importance, the current site is extremely difficult to conduct field work at. The channel shape at the site varies considerably, the area is subject to high fluctuations in flow with little ground above flood stage, is easily accessible by the public (and hence prone to vandalism), and requires sampling be done from a dangerous road bridge.

A site evaluation study will be conducted for the San Joaquin River boundary monitoring station site location to select the best potential site. Evaluation criteria will include access, security, channel morphology, seasonal stage height, etc. (MWQI, ESO, CD). The evaluation will include a lateral variability analysis of water quality across the channel to insure that water quality at the proposed platform site is representative of the channel flow, and is not skewed by lack of mixing or upstream inflows on either side of the channel.

Task 2A: Site reconnaissance/evaluation (MWQI, ESO, CD)

Task 2B: Draft and final Evaluation Study Report (MWQI, ESO, CD)

Task 3: Install TOC/DOC Autoanalyzer at Banks

Task 3A: Site Construction (MWQI)

Task 3B: TOC autoanalyzer purchase and installation (MWQI)

Task 4: Construct Monitoring Platform at selected site location on the San Joaquin River channel/ Delta Boundary

In addition to TOC/DOC, the new station will be designed to accommodate other water

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quality monitoring equipment for real-time, remote monitoring of parameters such as EC, pH, DO, temperature and turbidity. Participation by other DWR entities collecting this type of data (ESO, Central District, O&M) will be sought, and it is expected that long term use of the monitoring station will involve a partnership for operation and maintenance of the facilities.

Task 4A Develop Design Criteria and Plans (MWQI, ESO, CD, DOE)

Task 4B Construction (MWQI, ESO,CD,DOE)

Construction to be performed under contract or by Division of Flood Management

Task 4C Install and calibrateTOC Autoanalyzer Equipment (MWQI)

Task 4D Install and calibrate Multi-parameter Water Quality and (ESO)

Task 4E Install and calibrate Flow Monitoring Equipment (CD)

Participating Agencies

The Department of Water Resources (MWQI) would be the lead agency. MWQI will partner with other elements of DWR (ESO, Central District, O&M, DOE) in designing, constructing, operating and maintaining the monitoring station. A private consultant (currently under contract with MWQI) may provide project support, including technical advice and guidance.

Project Costs

(Preliminary estimates of projected costs)

Task	Agency	Cost
Task 1 Develop and Evaluate Real-Time TOC/DOC Autoanalyzer System, Install Tubidimeter, Flow Meter and Related Equipment		
1A Install and Calibrate Equipment:		
1A1 TOC autoanalyzer purchase, installation, calibration (incl. telemetry)	MWQI	$35,000
1A2 Purchase and install turbidity equipment	ESO	$5,000
1A3 Purchase and install flow monitoring station	CD	$20,000
1B Test Feasibility of TOC/DOC Autoanalyzer		

1B1 Sample for 1 year with Autoanalyzer and grab samples(labor)	MWQI	$20,000
1B2 Analyze grab samples for comparison to autoanalyzer (lab costs)	MWQI	$10,000
1B3 Evaluate autoanalyzer and grab sample data	MWQI	$5,000
1B4 Prepare draft and final feasibility report	MWQI	$5,000
Task 1 subtotal		**$100,000**
Task 2: San Joaquin River Site Evaluation Study		
2A Site reconnaissance/evaluation	MWQI, ESO, CD	$20,000
2B Draft and final Evaluation Study Report	MWQI, ESO, CD	$5,000
Task 2 subtotal		**$25,000**
Task 3: Install TOC Autoanalyzer at Banks		
3A Site Construction	MWQI, O&M	$10,000
3B TOC autoanalyzer purchase, installation, calibration (incl. telemetry)	MWQI	$35,000
Task 3 subtotal		**$45,000**
Task 4: San Joaquin Station		
4A Design criteria and Plans	MWQI, ESO, CD, DOE	$25,000
4B Construction	MWQI, ESO,CD, DOE	$138,000
4C TOC autoanalyzer purchase, installation, and calibration (incl. telemetry)	MWQI	$35,000
4D WQ Multi-Parameter equipment purchase, installation and calibration	ESO	$32,000
4E Purchase, install and calibrate flow meter	CD	$20,000
Task 4 subtotal		**$250,000**
TOTAL		**$420,000**

Project Schedule

The Project tasks covered in this workplan are expected to take two years.

Phase 1: Year One

Task 1. Develop, operate and evaluate real-time TOC/DOC autoanalyzer at Hood, with collection of approximately one year of ambient level data, including weekly grab samples for comparison purposes.

Task 2. Evaluate feasibility of potential San Joaquin River channel monitoring sites for selection of most representative site with adequate access and security, including an assessment to determine if any lateral variability of water quality exists. Evaluate data and make recommendations on adequacy of selected locations.

Phase 2: Year Two

Task 3. Install TOC/DOC autoanalyzer at Banks

Task 4. Construct San Joaquin monitoring station, install and calibrate equipment

Once established, the three real-time monitoring stations will be incorporated into DWR's system of water quality monitoring stations in the Delta, and will be maintained by DWR staff for long term use in collection of real-time water quality data. Data is expected to be available on a real-time basis through CDEC, and be posted on the Bay-Delta Tributaries Database. This data will be of critical importance to CALFED and others for the reasons discussed in the Background and Project Purpose Sections of this proposal.